APPENDIX TABLE. ANNUAL INFRASTRUCTURE INVESTMENT NEEDS (In billions of 1982 dollars)

| Infrastructure Category | Association of General Contractors | Joint Economic Committee | Congressional Budget Office |
|---|---|---|---|
| Highways and Bridges | 62.8 [a] | 40.0 | 27.2 |
| Other Transportation (Mass Transit, Railroads, Airports, Ports, Locks, Waterways)[b] | 17.5 | 9.9 | 11.1 |
| Drinking Water | 6.9 | 5.3 | 7.7 |
| Wastewater Treatment | 25.4 | 9.1 | 6.6 |
| Drainage | 5.6 | [c] | n.a. |
| Total | 118.2 | 64.3 | 52.6 |

SOURCE: The National Council on Public Works Improvement, *Fragile Foundations: A Report on America's Public Works*, from Association of General Contractors, *America's Infrastructure*; Joint Economic Committee, *Hard Choices* (February 1984); and Congressional Budget Office, *Public Works Infrastructure* (May 1983).

NOTE: n.a. = not available.

a. Highways only. Bridges were estimated separately at an additional, one-time repair cost of $51.7 billion.

b. The JEC study excluded needs for locks and waterways; the CBO study excluded needs for railroads.

c. Included under wastewater treatment.

structure investment and that this proportion is roughly that which existed in 1960 (the base year of the period under consideration). There are a number of reasons to question this judgment.

First, the optimal level of infrastructure investment relative to GNP will depend, in part, on the efficiency of infrastructure use. Policies that lead to more efficient use of infrastructure will reduce the amount of infrastructure needed per dollar of GNP (or of private investment). Examples of efficiency-enhancing infrastructure policies include:

- Using bus fleets rather than rail systems in all but the most densely populated localities;
- Establishing lanes for high-occupancy vehicles to increase roadway capacity during commuting hours;
- Consolidating small water-supply systems into regional systems that can substantially reduce the unit cost of drinking water; and
- Imposing fees for use of the air traffic control system, similar to peak-period landing fees already used at some airports, to increase the amount of traffic that the aviation system can handle.

These and other innovations would improve the productivity of public works capital and reduce the amount of investment needed to provide a given level of infrastructure services.

Second, the optimal level of public works investment should be expected to vary with the structure of the economy. The observed decline of infrastructure investment relative to GNP reflects, to some extent, the growing importance of services in the economy. For each dollar of GNP generated, the service and financial sectors require fewer transportation services and generate less pollution (thus requiring less environmental infrastructure) than does the manufacturing sector. As the relative importance of the service and finance sectors continues to grow, a smaller proportion of GNP needs to be devoted to infrastructure investments.

Finally, the country may not need as much new infrastructure investment as it once did. The relative decline in investment since the 1960s may reflect a transition from an era of construction to an era of management in public works. New Interstate highway construction, for example, generally provides a lower rate of return than does maintenance of the existing system.[1] A Bureau of Reclamation study recently concluded that, in many instances, the Bureau could ensure adequate water supplies most efficiently by concentrating on water

1. See Chapter I for estimated rates of return on highway spending of different kinds.

management and conservation rather than on construction.[2] In many instances, public objectives may be achieved more efficiently by improving management practices than by raising new construction outlays to the level of the 1960s. In short, the changing nature of infrastructure needs, and the lower returns to some infrastructure investment, make past investment levels a poor guide to future spending.

The "needs" and "use" studies cited by the Council are equally problematic. Needs studies tend to overstate required spending since they merely reflect the cost of repairing facilities to a given engineering standard, regardless of whether the benefits exceed the costs involved.[3] A study of water resources "needs," for example, might include the cost of building all of the projects that the Congress has authorized to be constructed. Yet, in 1986, the Corps of Engineers' budget request included 34 projects, with an expected final cost of $4.4 billion, that promised benefit-cost ratios of less than one when evaluated at a 10 percent discount rate.[4] Needs studies also ignore the savings possible from more productive use of existing capital--savings that can be substantial. Finally, both the "needs" and "use" studies inflate required spending by assuming that both technology and existing pricing policies will remain unchanged.

The Council's report contains numerous examples of the way in which new technologies and pricing policies can alter infrastructure demand.[5] To cite only one, the Council notes that when New York's Kennedy and La Guardia airports increased their landing fees, peak-period general aviation traffic fell by 30 percent, and peak-period delays in take-offs and landings declined by 50 percent. The Council's "needs" and "use" estimates would have been more useful if they had noted how infrastructure demand would change under the various policy reforms recommended by the Council.

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2. Department of Interior, Bureau of Reclamation, *Assessment '87* (1987).

3. A recent critique of needs studies can be found in Office of Management and Budget, "Supplement to Special Analysis D" (May 1988).

4. See Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986), pp. 39-40.

5. See the discussions on pp. 40-41 and 61-63 of National Council on Public Works Improvement, *Fragile Foundations: A Report on America's Public Works* (1988).

In the end, the Council's argument for a doubling of spending rests on a series of data whose true import is hard to fathom. Even if the data are taken to indicate that greater infrastructure investment is desirable, they provide no information about which infrastructure problems should be regarded as most pressing. And, in fact, the Council sets no priorities, either between or within infrastructure modes.

## Estimating Rates of Return

Given the ineluctable uncertainties in "needs" and "use" studies, policymakers may wish to consider other information when deciding on priorities and investment levels. In this regard, estimates of the rates of return from different infrastructure investments could be particularly useful, although the Council rejects the use of such studies when evaluating the existing infrastructure stock.

The Council finds four principal drawbacks to rate-of-return studies.[6] First, it argues that these studies would require far more data collection than is now used to support program decisions. But most federal (if not state and local) agencies now collect data sufficient to compute rate-of-return analyses on infrastructure investments. The estimated rates of return on highway spending cited earlier in this volume were based on data published by the Federal Highway Administration. The Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service routinely compute benefit-cost ratios--the informational equivalent of rates of return--for the water resources projects that they undertake. And the Urban Mass Transportation Administration now collects the data needed to estimate rates of return on new transit starts.

Second, the Council expresses concern that rate-of-return studies ignore unquantifiable benefits from infrastructure investments, such as improved national defense. Yet, policymakers need not exclude unquantifiable benefits from consideration simply because they have at hand a measure of a project's quantifiable benefits. It is hard to see, for example, how Congressional allocations of federal-aid highway funds could be harmed by the knowledge that, in addition to national

6. *Fragile Foundations*, p.51.

defense benefits, projects that merely would maintain the current condition of these highways would have rates of return estimated at between 30 percent and 40 percent, while projects that would fix all of the deficiencies would have negative estimated rates of return.[7]

Third, the Council argues that rate-of-return studies usually understate the benefits of public investment, since they ignore the effect of public capital on the productivity of private-sector capital. In fact, the rate-of-return studies made by federal agencies explicitly take into account the benefits to private entities. The Corps of Engineers' evaluations of lock and dam projects, for example, usually attempt explicit measurements of the benefits to shippers. Similarly, water project evaluations by the Bureau of Reclamation include estimates of the projects' value to farmers.

Finally, the Council states that measuring rates of return is not useful "because it is difficult to . . . value future public benefits." In fact, the theory of measuring future public benefits has long been well developed.[8] While current estimating practices might be improved, such estimation is not inherently intractable. The argument in favor of less-than-perfect estimates of rates of return is not that they eliminate uncertainty, but only that they can reduce it. And, of course, one could develop a range of rates of return to reflect the uncertainty in these estimates.[9]

This is not to suggest that rate-of-return analyses should be the sole or even primary determinant of infrastructure investment priorities. Many truly unquantifiable considerations have gone into such decisions in the past, for infrastructure investment has been designed to achieve a variety of social goals such as mobility (and the social, economic, and cultural integration that mobility might bring about) and income redistribution. Moreover, rate-of-return analyses can help the Congress little in deciding how to allocate funding between infra-

7. See Chapter I of this report.

8. See the discussion and citations in Richard Tresch, *Public Finance: A Normative Theory* (Plano, Texas: Business Publications, Inc., 1981).

9. For a rate-of-return study that includes a range of outcomes reflecting the uncertainty surrounding the estimates, see Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace Plan* (August 1983).

structure investment and social welfare programs, since the benefits of the latter are more difficult to measure.

## METHODS OF FINANCING INFRASTRUCTURE

The Council recommends that beneficiaries pay a greater portion of infrastructure costs, and it reviews various ways by which this might be accomplished. The Council carefully reviews the benefits and limitations of such a policy. User fees, in particular, offer managers important information about the demand for facilities; provide infrastructure users with incentives to use facilities efficiently; and can produce the revenue stream needed for timely maintenance, rehabilitation, and replacement of facilities. The usefulness of fees is limited, however, if public works are intended to redistribute income, or if subsidies are needed to correct externalities (as in the case of wastewater treatment grants that compensate localities for the benefits they provide to others on a common waterway by treating municipal wastes).

### Mechanisms Other Than User Fees

The Council considers a number of mechanisms in addition to the direct application of user fees by which the "beneficiary pays" principle could be carried out. These include earmarked revenues, the creation of special districts or authorities, and the use of infrastructure trust funds. The Council finds that each has its advantages and disadvantages.

Earmarked revenues and trust funds can improve support for infrastructure finance by offering voters a more distinct link between benefits and costs. Yet, if insulated from general-purpose budget pressures, these funding mechanisms can bind lawmakers to outdated priorities; and if not isolated from these budget pressures, they are not likely to be more effective than existing financing mechanisms.

Special districts that have both independent revenue sources and boundaries drawn to take advantage of the economies of scale can provide infrastructure services more cheaply than some multipurpose governments. The Council concludes, however, that a lack of indepen-

dent revenue sources, inadequate accountability to voters, and poorly drawn boundaries have made existing districts, on average, no more efficient as infrastructure providers than the average multipurpose government.

Most generally, the Council's discussion indicates that while these devices may be useful in some circumstances, none can substitute for a political consensus on the proper amount of infrastructure.

### Effects of Tax Reform

The Council also reviews the effect of the 1986 Tax Reform Act (TRA) on state and local infrastructure finance. The principal tax subsidy for state and local infrastructure investment is provided by the exemption from federal income tax of interest paid on some state and local bonds. The TRA included a host of provisions that, taken individually, would have limited the value of this subsidy. But many of these provisions will have offsetting consequences, so that taken together their effect will be less substantial.[10] The Council report reviews the TRA provisions that restricted the value of this subsidy, and urges the "removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing." But the Council neither specifies the federal tax provisions that it considers unwarranted nor addresses the question of whether tax subsidies are more efficient than direct outlays as a way for the federal government to support public works investment.

## GOVERNMENT ROLES

The Council surveys the existing roles of federal, state, and local governments in providing infrastructure, and reviews the literature on the different role that each level of government might play. The Council concludes that while "policy should support local self-sufficiency to the greatest extent possible," all levels of government should

10. See statement of Edward Gramlich, Acting Director of the Congressional Budget Office, before the Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, September 17, 1987.

share some degree of accountability for infrastructure as a whole, since the effects of most public works "are not neatly locked within the boundaries of any given jurisdiction." The Council would assign primary responsibility for infrastructure as follows:

- *Federal*: highways of "national significance"; air traffic control; inland waterways; environmental standards; hazardous waste cleanup; flood control.

- *State*: highways of "statewide significance"; wastewater treatment capital outlays; airport planning; waste disposal siting; dam safety.

- *Local*: local roads and bridges; mass transit; airports; ports and harbors; water supply; wastewater treatment operations and maintenance outlays; solid waste disposal; water supply.

The Council also reviews the variety of ways in which the federal government can subsidize state and local infrastructure outlays. The effects of these subsidies often differ not only with their amount but with their form. While the Council notes the incentives offered by optimally designed subsidies, it ignores the incentives of those that are imperfectly set. It notes, for example, that categorical matching grants could be the most effective way for federal subsidies to increase state and local outlays for a particular kind of infrastructure. Yet, existing infrastructure matching grants are "closed"--that is, the government matches state and local spending only up to a predetermined amount. Econometric studies have consistently found that the combination of high matching rates and low ceilings on the amount that the federal government will match has allowed grant recipients to use much of the federal money as a substitute for, not complement to, their own spending.[11]

11. This literature is reviewed in Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

## EFFICIENCY OF PUBLIC WORKS SPENDING

The Council explores a number of policies designed to improve the efficiency of infrastructure outlays.[12] The proposals include:

- Choosing solutions from a broader range of infrastructure projects;
- Evaluating alternative infrastructure projects in a more consistent fashion;
- Using more timely operations and maintenance outlays to minimize the cost of infrastructure services;
- Greater use of nonstructural alternatives such as demand management; and
- Regional cooperation to take advantage of the economies of scale present in many kinds of infrastructure investments.

The Council argues that states and localities could be encouraged to adopt these policies by limiting the restrictions placed on the use of federal infrastructure grants. The arguments for and against this approach are discussed in Chapter VI above. The Council makes no estimate of how such efficiency measures might affect the desired level of public works investment.

## PROMOTING RESEARCH AND DEVELOPMENT

The Council reviews the various reasons why private firms tend to underinvest in public works research and development. Most important, a firm cannot garner for itself the benefits of its research, since others cannot be prevented from appropriating the results of its R&D. In addition, common infrastructure procurement practices fail to give private firms incentives to develop cost-minimizing methods

12. Most of these policies are evaluated in Congressional Budget Office, *Federal Policies for Infrastructure Management.*

and materials, since these practices often emphasize initial costs rather than life-cycle costs.[13]

Because of these problems, the federal government funds a number of infrastructure research efforts. The Strategic Highway Research Program funds research aimed at improving the productivity of paving and bridge materials; and the Congress recently enacted legislation that would establish a university-affiliated transportation research center in each of 10 regions. Federal agencies also help spread research results through programs such as the Department of Transportation's technology-sharing program. The Council urges the creation of a new national research program, with an emphasis on coordinating and setting priorities for existing research efforts.

13. The economic and social barriers to infrastructure innovation by private firms are detailed in Office of Technology Assessment, *Construction and Materials Research and Development for the Nation's Public Works* (June 1987); and National Research Council, *Infrastructure for the 21st Century* (Washington, D.C.: National Academy Press, June 1987). These reports lay the basis for the Council's recommendations.